

# **Safety in the Use of Disinfectants in the Health Services**

**Consensus paper  
from the basic German and French documentation**

**Working document for occupational safety and health specialists**



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## **Safety in the Use of Disinfectants in the Health Services**

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In 1993, the Bureau of the ISSA Health Services Section created a Working group to study health risks related to the use of chemical products in the health sector. This Working group seats representatives from the German Institution for statutory accident insurance and prevention in the health and welfare services (BGW, R. Ahrens and U. Eickmann), the French National research and safety institute (INRS, M. Falcy), the French Regional health insurance fund (CRAM de Bretagne, L. Beaudouin), and the Swiss National accident insurance fund (Suva, M. Rügger and M. Jost, the Working group's chairman).

This paper has been developed as a consensus statement from the basic German<sup>1</sup> and French<sup>2</sup> documentation on disinfection tasks generated by the Chemical Risks Working group of the ISSA Health Services Section in 1997. It summarizes the Working group's thinking on the basis of contributions from the various countries, and the questions raised by these contributions. These questions are:

- What are the interfaces between hospital hygiene and health protection in disinfection tasks?
- How can disinfection-related hazards be evaluated using occupational disease statistics and epidemiological data?
- How can the potential hazard on the job be assessed concretely (room air measurements, biological monitoring, calculation of concentrations using models and analog reasoning)?
- What technical, organizational and personal protective measures are applicable for different disinfection processes?
- How should workers exposed to disinfectants be monitored medically?

The basic documentation addresses only the occupational risk prevention aspects, considering the main classes of disinfectants, which are aldehydes, alcohols, biguanides, quaternary ammonia compounds, and phenol compounds, but not iodine or chlorinated compounds, acids, or peroxides. The following points are examined hereafter:

1. Risks for health care workers
2. Risk assessment approach
3. General prevention principles
4. Prevention measures applicable in the use of disinfectants
5. Special disinfection methods
6. Medical surveillance

The present recommendations apply not only to hospitals but also to all health organizations and institutions such as doctors' offices, nursing homes, convalescence centers, and to home care.

They may also be applied to disinfection tasks outside the health services after adaptation in consultation with the occupational physicians and the safety specialists concerned.

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# **1. Risks for health care workers**

Exposure to disinfectants may have effects on health. The main symptoms are skin irritation or allergic contact eczema. Less common symptoms are irritative or allergic respiratory diseases. Possible systemic effects of individual disinfectant components should also be mentioned.

The following disinfection methods may present special health problems for employees.

## **1.1. Room disinfection**

When rooms are disinfected with formaldehyde in gas or liquid aerosol form, very high exposures to this substance may occur. As it is practically impossible to seal off the room perfectly, concentrations above the limit values can be measured even outside the disinfected room. Even after adequate neutralization, non-negligible residual concentrations of formaldehyde are sometimes measured, due to the conversion of hexamethylene tetramine into formaldehyde. Rooms should therefore be disinfected only if strictly necessary (under the terms of national regulations or upon indication by the hospital hygienist) and if a standard neutralization procedure is applied, along with all of the recommended protective measures (see section 5.6). These recommendations are to be modified accordingly when using other substances for gassing or atomization.

## **1.2. Spray disinfection**

In comparison to the scrub-wipe method, spraying causes relatively high atmospheric concentrations of some disinfectant components. Spray disinfection is easy, but considering the risks it raises for workers, it should be replaced by the scrub-wipe method.

## **1.3. Surface and floor disinfection**

There is less exposure by inhalation when disinfecting surfaces and floors than when the processes mentioned in sections 1.1 and 1.2 are used; but skin contact can be intensive. The atmospheric concentrations of disinfectant substances will depend mainly on the surface area to be disinfected, the quantity and concentration of the disinfectant, the volatility of its components, and room ventilation. The disinfection instructions (section 3.2) should therefore specify the surface area to be disinfected and the concentrations to be used. From the viewpoint of hospital hygiene, any unnecessary surface disinfection is to be strictly avoided.

## **1.4. Instrument disinfection**

Inadmissible atmospheric concentrations of disinfectants (alcohols, aldehydes) may occur when disinfecting instruments by hand, in an uncovered ultrasound bath or in an open pan. Technical measures are then to be taken in order to reduce exposure. In general, concentrations are lower with automated processes than they are with manual disinfection. Automated disinfection is thus recommended.

## **1.5. Other hazardous situations**

- Disinfection with high concentrations. This kind of disinfection is performed to meet specific indications and should be performed only when effectively necessary under the terms of national regulations or if so assessed by the hospital hygiene expert.
- Mixtures of disinfectants. Depending on the individual components used, disinfectant "cocktails" can create hazards due to chemical reactions or reaction products. This is notably the case when acidic and basic disinfectants are mixed. Disinfectant mixtures can thus lead to hazardous situations.
- Deviation from routine. When there is a failure making it impossible to use a routine procedure, healthcare workers may be tempted to deviate from approved methods. The use of unapproved procedures must be avoided in such cases. It is preferable to carry out the disinfection once this can be done without danger. It is advisable to provide for substitute procedures to be followed in case of automatic system failures or "bottlenecks" arising for technical reasons.
- Waste disposal. Here again, make sure not to mix substances that may react chemically and form dangerous products.

## **2. Risk assessment approach**

The use of disinfectants requires a risk assessment on a case-by-case basis. The following aspects must be borne in mind:

- Analyzing the disinfection methods (products, application, prevention means)
- Collecting data on modes of action and effects of products from:
  - the literature
  - databanks
- Assessing exposures:
  - databanks
  - measurements (atmospheric, biological)
  - calculations

National regulations concerning workplace evaluation and monitoring must of course be observed.

Workplace evaluation is mandatory in the following cases:

- New workplace
- New disinfection processes with known products
- Use of new disinfectants
- Any personnel complaints suspected to be due to the effects of disinfectants
- Arrangement of premises or ventilation conditions suggestive of risks
- Atypical environmental conditions (such as high temperatures)

Aside from the general data collected when inspecting a workplace, a disinfectant-related risk evaluation can also be based on atmospheric monitoring, biological monitoring, and estimations of atmospheric exposure by mathematical and analogue models.

The following procedure is recommended for workplace evaluation:

### **2.1. Analysis of disinfection procedures**

The record on the disinfection procedure should contain all information of relevance for the protection of workers: product used, concentration used, mode of use, disinfection apparatus (open/closed, with or without exhaust), room size, room ventilation, personal protective measures.

### **2.2. Collecting data on the effects of substances**

The following sources are available for information retrieval on the possible effects of disinfection product components:

- Literature.
- Occupational disease statistics. This can give a rough estimate of potential hazards, especially as concerns the effects of the components on the skin and respiratory tract. As the criteria for recognizing occupational diseases differ from one country to

another and the statistics leave out certain hazards that can only be identified by toxicological or epidemiological surveys, data collection should not be limited to an analysis of occupational disease statistics.

- Databanks.
- Medical surveillance. Analyses any complaints by personnel that may stem from exposure to or contact with disinfectants.

## **2.3. Assessment of exposure**

### **2.3.1. Databanks**

It may be useful to consult databanks containing measurements of disinfectant concentrations as a function of certain parameters. The INRS' Colchic database of exposures to chemical substances (for use by members of the occupational risk prevention institution) provides disinfectant concentration measurements for different workplaces in France. In Germany, the Hauptverband der gewerblichen Berufsgenossenschaften in Sankt Augustin manages the Omega databank of exposures at the workplace.

### **2.3.2. Air and biological monitoring**

In many cases, it is already possible, on the basis of hazard assessment and literature data, to determine if disinfection tasks entail an exposure that is of relevance in the context of occupational hygiene and occupational medicine disinfection products, under reserve that the working procedures are similar.

The working conditions observed can be compared with known situations. For tasks like disinfecting surfaces and floors, it is often sufficient to simply analyze the work area in order to conclude on the conditions at the workplace.

Depending on the specific situation at the workplace, the following measures are recommended:

*a) Air monitoring.* Currently it would be preferable to take room air measurements rather than assessing disinfectant concentrations based on calculation procedures. Air monitoring is especially useful in cases of exposure to aldehydes, and also to alcohols. When using other disinfectants, air monitoring is rarely relevant due to the physical properties of these disinfectant components.

Whether workplace evaluation should entail room air measurements of disinfectant components depends on the workplace inspection, the facilities for room air measurement and the existing basis for evaluation as well as on the national regulations. Room air measurements for complete workplace evaluation are recommended especially when using new disinfectants as well as when personnel and patients are suffering complaints.

Other factors may also justify air monitoring:

- For purposes of developing an exposure map for disinfection processes
- For research purposes
- For products that are worrisome to public opinion or are feared by the personnel



**b) Biological monitoring.** When performing disinfection tasks, biological monitoring is beneficial only when skin absorption of disinfectant components is to be expected, and on condition that reliable reference values are available.

### **2.3.3. Calculation procedures**

Only validated calculation procedures should be used.

Mathematical models are used today only when it is impossible to make measurements for logistical reasons. Model calculations may be used in place with air monitoring for scientific reasons, so that any workplace parameters exerting an influence on the disinfection concentration can be identified and databanks compiled for later workplace assessments without having to resort to room air measurements.

## **2.4. Practical approach**

Two types of approaches are possible in practice:

- If it is apparent that the prevailing occupational hygiene conditions are inadequate, technical, organizational and person-related measures in the context of the protection of workers can first of all be recommended or taken from experience without engaging in further clarification; further investigations are required only if there is uncertainty after taking these measures.
- In unclear situations, the first step is a more thorough examination of the workplace in accordance with sections 2.3.1 to 2.3.3 before deciding what technical, organizational and personal protective measures are to be applied.

For some disinfection methods, a pragmatic approach can be developed from a preliminary evaluation of the workplace without any need for room air measurements first. A primary requirement for disinfecting operating rooms, for example, is the wearing of a respiratory protective device, so room air measurements are of no use in this case. An exhaust system is required when disinfecting endoscopes. Room air measurements are only needed if no suitable technical preventive measures have been taken.

## **2.5. Detection of new problems**

Various types of measures can be applied to identify new problems stemming from disinfection tasks:

- Medical surveillance: assessment of complaints among personnel that may result from contact with or exposure to disinfectants.
- Notification of new disinfection procedures and new disinfectants to the occupational physician and safety specialists.
- Periodic inspections of the premises by the occupational physician and safety specialists.

## **3. General prevention principles**

### **3.1. Hospital hygiene and occupational risk prevention**

Hygiene specialists (*i.e.*, hospital hygienists and persons conducting disinfection) are to have received training in accordance with national regulations both in the fields of hospital hygiene and occupational risk prevention during disinfection tasks. A distinction must be made between planning and execution expertise. Hygiene specialists should have a decision-making role only in their field of qualification. Persons who perform disinfection are to follow the instructions of hygiene specialists or hospital hygiene experts. Hospital hygiene experts are to consult doctors, occupational hygiene specialists, or safety specialists for questions of occupational hygiene or risk prevention. Close cooperation is thus recommended among hospital hygiene experts and occupational physicians and safety engineers.

### **3.2. Avoiding unnecessary worker exposure to disinfectants**

In the general framework of hospital hygiene measures, it is always important to take the protection of workers into account. The following recommendations are made to avoid any worker exposure to disinfectants that might be qualitatively or quantitatively unnecessary:

- The attempt should be made to provide satisfactory disinfection with a minimum of different products and processes.
- Every hospital should have a hospital hygiene expert it can consult.
- The disinfection processes to be applied must not be left to the discretion of the users, but should be specified in concert with a hospital hygiene expert.
- The competence authorities in the various countries publish lists of authorized disinfectants and processes, which are to be complied with.
- Instructions should be written for the use of disinfectants and antiseptics. Among other things, these instructions should specify the choice of products, concentrations, frequency of use, when the product is to be used, and the process itself. These instructions should clearly lay out the lines of authority in matters of hospital hygiene and disinfection processes, from the hospital management to the level of the services. The competent occupational safety and nosocomial infection prevention committees or entities are to be involved in this analysis. The disinfection procedures and methods are to be set down in writing and always consider the dual aspects of process efficiency and occupational risk prevention. These documents must be updated periodically. The fact of imposing uniform procedures and clear methods should prevent unnecessary disinfections, and the use of unnecessarily high concentrations of disinfectants or the use of processes that raise problems.

### **3.3. Check of disinfection procedures**

The disinfection procedures used are to be checked systematically to make sure they have been explicitly recommended by a hospital hygiene expert. The procedure is to be evaluated jointly by the occupational physician and occupational safety specialist in order for occupational risk prevention to be taken into account. This type of check is especially justified for disinfection procedures applied to sanitary facilities, floors, or furniture in patients' rooms.

### **3.4. Room layout**

When premises are poorly designed and the materials unsuitable, and when surfaces do not lend themselves well to disinfection, various factors may cause an increase in the atmospheric concentration of disinfection products (as use of increased disinfectant quantities, prolonged action time, or incomplete neutralization after room disinfection). Already at the time of drawing up plans for rooms in the health services, the requirements regarding subsequent disinfection tasks should be taken into consideration.

### **3.5. Replacement of products**

From the occupational hygiene and medical viewpoint, it would be desirable to replace disinfectants whose components raise toxicological problems with other products that pose fewer risks. However, it is not always satisfactory to replace disinfectants that have long been in use and whose toxicological properties are well known with other new products whose unfavorable effects may only crop up later. Generally, when selecting a product, the occupational risk prevention and environmental protection aspects are to be considered. Between two products of comparable toxicity and equal efficiency, the one requiring the lesser concentration or lower vapor pressure (with less inhalation risk), whose sensitizing power (for respiratory tract and skin allergies) is lower, and for which no carcinogenic potential is mentioned, is preferable.

### **3.6. Deployment of outside companies**

If outside companies are deployed for disinfection tasks, disinfection should be planned and performed according to accepted practices. The agreement reached between the institution's management and the outside company entrusted with disinfection after consultation with the hospital hygienist must also be clear in respect of aspects of health protection. This agreement should specify the role of the persons responsible for the planning and execution and those performing disinfection but without expertise in respect of work, protective measures and skills specific to disinfection tasks in hospital settings. It is recommended that a coordinator be appointed.

### **3.7. Allocation of responsibilities**

In addition to responsibilities vis-à-vis patients, the employer bears responsibility for occupational safety and health. The employer should therefore actively promote risk assessment and protective measures in disinfectant tasks.

## **4. Prevention measures applicable in the use of disinfectants**

By their principle, disinfectants have a targeted action on living organisms. In particular, they act on the metabolic processes of microorganisms, which are comparable to those of the human metabolism. Therefore toxicity of disinfectant components must always be assumed.

Accordingly, based on the risk assessment outlined in section 2, it must be established whether and which protective measures must be taken for disinfection tasks. The main criteria applied for risk assessment are the results of room air measurements compared with the occupational exposure limit (OEL) as well as measurement of biological material compared with the biological substances tolerance levels provided that such limit values have been stipulated. It must be investigated whether especially hazardous substances are being used, such as those that irritate the skin, conjunctiva and airway mucosa, substances with sensitizing effects, carcinogenic, genotoxic or teratogenic effects or substances with a high vapor pressure. If no OEL has been specified for a substance, comparison of the measured room air concentrations and the biological measured values with the No Observed Effect Level (NOEL) is essential. These have been obtained on the basis of animal experiments or epidemiological investigations. Finally, the duration of daily or weekly exposure of workers must be taken into account.

The protective measures to be taken depend on the results of the workplace evaluation.

### **4.1. Substitution of disinfectants and disinfection procedures**

It is preferable to replace chemical processes with thermal processes, or a product containing toxic compounds with one that poses less of a problem. However, this is not always possible for a number of reasons (see section 3.5).

### **4.2. Technical measures**

#### **4.2.1. Room layout**

In the health sector, the possible need for disinfection or for performing disinfection tasks should be planned for at the room design stage. Surfaces must be easy to disinfect, and ventilation adequate. It must be possible to seal off certain rooms (especially infection departments and operating rooms). Routine disinfection tasks should be carried out in rooms that are sufficiently large and well ventilated.

#### **4.2.2. Automated procedures and technical aids**

Automated procedures and technical aids that preclude contact between the disinfectants and employees are recommended. For example, the automatic systems used for disinfecting endoscopes and instruments reduce skin and respiratory tract exposure when the facilities are well designed and maintained in accordance with the manufacturer's instructions. Dosing aids, accessories for wringing mops, cleaning machines with exhaust systems for removing excess disinfectants, for example, have proven their effectiveness.

#### **4.2.3. Capture**

Removal of hazardous substances at the source is the most effective way of reducing exposure. One example of an application is the capture of pollutants at the source, in manual endoscope disinfection systems.

#### **4.2.4. Room ventilation**

Room ventilation is very important in disinfection tasks. If volatile products are used, the ventilation must be in operation at highest power during the disinfection. Periodic checks of room ventilation effectiveness are to be made.

### **4.3. Organizational measures**

The following are the main organizational measures:

- Selection of disinfection process
- Writing clear work instructions
- Compliance with established procedures
- Training and briefing of employees
- Assignment to disinfection tasks
- Compliance with employment restrictions
- Room air monitoring strategy

#### **4.3.1. Selection of disinfection process**

Generally, it is important that the exposure to disinfectants be as brief as possible. To avoid exposing people who are not entrusted with disinfection tasks, surface disinfection should not be performed in a room while other people are performing other work in the same room. This is aimed at ensuring that disinfection tasks cause as little exposure as possible to other personnel (such as nursing or technical workers).

#### **4.3.2. Work instructions**

Disinfection task principles should be set down in writing in each institution. They should include the general occupational safety/hygiene and hospital hygiene rules, along with clear directions for using specific processes and, as the need may be, include a checklist.

Substitute procedures to be used in case of process failure must be given special attention and be integrated into the work organization. When the failures are of a kind that prevents application of the usual procedures, the substitute procedure must not include any greater risk for the personnel. All improvisation is to be avoided. When no substitute procedure is provided for, work is simply to be stopped until such time as the usual or similar methods can be applied again. It is important to ensure preventive maintenance for all apparatus used in disinfection tasks, and to check their operation regularly, in order to avoid such failures.

#### **4.3.3. Compliance with established procedures**

In order to optimize the efficiency of the disinfection tasks and avoid unnecessary exposure, it is important to follow carefully the procedures established by the manufacturer and personnel in charge of hospital hygiene. This mainly means that the surfaces and rooms are to be disinfected only in compliance with the hygiene specialist's instructions, that exactly concentrations provided for are to be used, and generally, that the disinfection tasks are to be performed only when indicated by the hospital hygiene expert.

#### **4.3.4. Training and briefing of employees**

Personnel performing disinfection tasks are to have received appropriate training in hospital and occupational hygiene, and disinfection procedures. This training is to be renewed periodically. The institution is to keep a record of personnel training courses and briefings. The occupational physician and/or occupational safety specialist should be associated with personnel training.

#### **4.3.5. Assignment to disinfection tasks**

In order to reduce the exposure time of people performing disinfection tasks, and the time individual protective equipment is to be worn, an attempt should be made to diversify the various activities. The wet work and the disinfection tasks should, insofar as possible, be distributed among several people. There should be no medical contra-indication against performance of disinfection tasks either.

#### **4.3.6. Compliance with employment restrictions**

National regulations and European directives lay down the applicable employment restriction rules. In some countries, employment restrictions come under preventive occupational medicine.

- People suffering from an occupational disease. Assignment of workers afflicted by an occupational disease due to disinfectants is to be determined by the occupational physician.
- Pregnant women. The assignment of pregnant women to disinfection tasks is to be examined on a case basis in light of the labor situation. In Germany, for example, pregnant women must not be employed in tasks entailing a high risk of infection, nor entailing exposure in excess of limit values. Refer to the European directive on protection of pregnant workers and workers who have recently given birth or are breastfeeding.
- Young people.
- Temporary personnel (France).

#### **4.3.7. Room air monitoring strategy**

A measurement program is especially in order when the first room air measurements reveal a concentration in excess of limit values. The tracking program should check the effectiveness of the preventive measures used. When the initially measured concentrations are less than 0.25 to 0.3 of the threshold limit value (TLV), there is generally no reason to continue this tracking program if all of the parameters affecting product concentration have been correctly taken into account. When the disinfection concentrations measured during evaluation of a workplace are between 0.25-0.3 of the TLV and the TLV, the desirability of tracking is evaluated on the basis of experience with the values usually measured for the same disinfectants applied by similar processes. If enough measurement data is available for the same disinfection process using the same product, no concentrations exceeding the TLV have been observed, and no complaints by personnel have been recorded, no air measurements are required. In Germany, monitoring measurements may be omitted only if the technical rules for hazardous chemical products (TRGS 402) are complied with.

When the air concentrations exceed the TLV, measures must be taken to reduce exposure, followed by another evaluation by air measurements.

#### **4.4. Personal protective measures**

The individual protective measures for disinfection tasks include:

- Skin protection and suitable gloves
- Protective clothing
- Goggles
- Respiratory protective devices

##### **4.4.1. Skin protection and gloves**

Each institution is to define the skin protection principles in a skin protection plan with a dual objective: to reduce the risks of occupational diseases due to disinfectants and wet work, and to protect against infectious agents.

The essential skin protection principles are the following:

- Insofar as possible, avoid direct skin contact with disinfectants by using appropriate equipment.
- Avoid "ritual" hand disinfections. Only specific disinfectants are to be used for disinfecting the hands, in accordance with the hospital's plan. Any unnecessary disinfection is to be avoided.
- Gloves are recommended when disinfectants are handled regularly, and especially when contact with the disinfectants cannot be avoided. This rule applies to all disinfection tasks, especially when using concentrated solutions or sensitizing substances, for long-duration or repetitive tasks, and in cases of special individual sensitivity. This rule should be waived only under exceptional circumstances, for short-term operations (a few minutes per day) when diluted solutions are used. An effort should be made to diversify the tasks so that it is not necessary to wear gloves continually ("glove breaks") and that they have to be worn as briefly as possible. The glove quality should be suited to the foreseeable mechanical stresses, offer adequate

protection against permeation by the disinfectants, satisfy hygiene requirements, and offer sufficient comfort and satisfactory protection against biological risks. Generally, close-fitting elastic gloves are preferable for precision work, but special attention should be paid to problems raised by latex. Nitril and butyl rubber gloves, for example, have a high enough mechanical strength and can be used for tasks that do not require high tactile sensitivity.

- To help the user choose gloves with sufficient impermeability to disinfection products, manufacturers should be required to provide information concerning the permeation characteristics of the glove materials, or compliance with certain standards.
- Wearing gloves can have side effects including, primarily, immediate-type allergies to latex with contact urticaria syndrome that can even result in anaphylactic shock. There also exist delayed hypersensitivity to rubber additives, and less commonly to latex proteins, and cases of primary irritation caused mainly by increased perspiration with skin maceration during prolonged use. Hands should be dry when gloves are worn. When latex gloves are used, it is preferable that they be powder-free.
- It is recommended that nitril or butyl rubber gloves be worn for disinfecting large surfaces.
- Skin protection also requires the application of skin care products (such as creams, ointments, or foams) before and during work, or the application of a lipid-rich moisturizer after work, and generally a cleansing with a non-aggressive, preferably neutral product. Hands should always be dried carefully.
- When products with high vapor pressure are used, it is recommended that protective product also be applied to the face and neck.
- Watches or jewelry that can reduce the effectiveness of protective gloves should be prohibited.

#### **4.4.2. Protective clothing**

It is recommended that appropriate clothing be worn for disinfection tasks.

Depending on the kind and extent of work to be done, it may be necessary to wear additional protective clothing to prevent contact with disinfectants.

- It is recommended to wear impermeable aprons when decanting disinfectant concentrates.
- It may be necessary to wear impermeable overalls when using large quantities of disinfectants.
- Special protective clothing is needed for handling wastes and cleaning waste elimination facilities with phenol derivatives.
- Special protective clothing is needed for work in which aerosols form or in which there is also a risk of infection.

If non-impermeable clothing is ever contaminated, it should be removed and the skin should be rinsed with water.

The hospital is responsible for cleaning protective clothing, including when this is used by subcontracting firms.



#### **4.4.3. Goggles**

Goggles should be worn when there is a risk of splattering disinfectant into the eyes. Goggles are thus recommended in the following cases:

- when handling concentrated disinfectants in an unclosed system
- when cleaning endoscopes and instruments manually
- when repairing equipment
- when using products containing phenol, such as for the elimination of infectious matter and cleaning draining devices

#### **4.4.4. Respiratory protective devices**

A full-face mask with filter is necessary when disinfecting rooms with disinfectants in the form of liquid aerosols. For tasks involving formaldehyde, a B2P2 or B2K2P2 filter (which also protects against ammonia) is generally used. It should be checked during each workplace analysis if this type of mask is suited to the risk (see section 2.1).

A mask with appropriate filter should be used when concentrated solutions of disinfectant are applied, or when experience shows that there is a risk that the limit values may be exceeded.

Attention is drawn to the following points:

- Workers should receive training in using and maintaining masks.
- Masks are to be maintained in accordance with good practice, and filters are to be changed regularly.
- Each person is to be furnished with his own mask.
- The mask must be well fitted to the face. Seal problems may arise if the person wears a beard.
- The mask is to be properly stored.

Also refer to ISSA publications and EU directives concerning the use of masks.

## **5. Special disinfection methods**

### **5.1. Surface disinfection**

The following principles are applicable to surface disinfection:

- Each hospital is to specify which surfaces are to be disinfected, in a written document on the use of disinfectants and antiseptics.
- Make sure that the rooms and furnishings to be disinfected raise no problems in this respect:
  - The surfaces are to be designed in such a way that they are easy to disinfect.
  - The floor should be perfectly even to avoid the formation of puddles.
  - Corners should be rounded so as not to retain substances.
  - The furniture should stand high enough off the floor so that the floor can be completely disinfected and dried.
- Disinfectants should always be used in the lowest possible concentration.
- Disinfection tasks are to be carried out in such a way that no surfaces are unnecessarily wetted and that no puddles form, so that there is as little evaporation as possible.
- From the occupational hygiene viewpoint, the two-bucket method is preferable to the one-bucket method.
- Splashing and aerosol formation are to be avoided when carrying out disinfection.
- Avoid preparing disinfectants with hot water.
- The room ventilation system must be operated at maximum power during the disinfection tasks, and until the surfaces are dry.
- Alcohols are preferably not used for surface disinfection. Whenever they are used, the area of the disinfected surfaces is to be limited because of the risk of explosion.

### **5.2. Spray disinfection of surfaces**

Spray disinfection of surfaces is to be avoided. In those rare cases when it may be necessary, the hygiene specialists are to define the procedure in cooperation with the occupational physician and occupational hygiene specialist.

### **5.3. Disinfection of small instruments**

When disinfecting small instruments, there are not only the disinfectant-related risks but also the risks of transmitting infection through the blood (such as HIV [human immunodeficiency virus], HBV [hepatitis B], or HCV [hepatitis C]) if the worker is injured by the instruments themselves.

The following principles are applicable to the disinfection of small instruments:

- Concerning the rooms, small instruments should be disinfected only in rooms that can be ventilated. Rooms should be reserved for this purpose in the hospital.
- The room ventilation system should be in operation at maximum power during cleaning and disinfection tasks, and remain on until the work is completed.
- Concerning preparation for disinfection, instruments should be stowed by type in the disinfection pans/recipients/apparatus, to limit the risks of injury. Small instruments should be placed in baskets so that they can be transported together without handling them separately. Instrument baskets should not be too large, lest they will be too heavy to handle.
- Concerning automated processes, it is important to determine if automated processes can be used, especially for cleaning. This applies especially to dentistry equipment.
- Vapor emissions from automatic cleaning/disinfection apparatus should be drawn off and exhausted to the outside, not into the room.
- Pans containing volatile components are to be covered.
- Disinfectant solutions are to be eliminated and disposed of in such a way that there is no risk to the environment.

#### **5.4. Disinfection of endoscopes and large instruments**

The following principles are applicable for the disinfection of endoscopes and large instruments:

- It is important to avoid exposing other members of the personnel and patients to disinfectants. Endoscopes in particular should be disinfected outside the examination room, in a separate room.
- Room ventilation. Disinfection tasks should be performed only in rooms that can be ventilated. The room ventilation system should be in operation at maximum power during disinfection tasks, and remain on until work is completed.
- Automated methods. If an automatic method is used for disinfecting endoscopes and large instruments, the disinfectant concentrations measured in the room air are much lower than with manual disinfection, so automated methods should be used whenever possible.
- Local exhaust is recommended for regular manual endoscope disinfection tasks.
- It is important to use skin protection and suitable gloves for manual endoscope and instrument disinfection.
- Disinfection baths must be covered.
- Automatic disinfection apparatus is to be maintained regularly.
- Air concentrations of disinfectant are high for a brief period when automatic disinfection apparatus are being maintained. Room ventilation is then to be set at maximum power. A suitable mask (see section 4.4.4) is needed if this ventilation does not lower the air concentrations enough. The risk of splattering also requires the wearing of protective goggles.

## 5.5. Bed disinfection

Beds are to be disinfected in accordance with a hygiene specialist's instructions. Hygiene measures based exclusively on habit are to be dropped.

The following principles are to be observed:

- Beds are to be disinfected in suitable and correctly ventilated rooms.
- Centralization and automation of the disinfection process. Centralized bed disinfection has advantages from the viewpoint of occupational hygiene. The automatic system is to be designed in accordance with the applicable national regulations and provision is to be made for system maintenance.
- When bed disinfection is centralized, the unclean, working, and clean areas must be clearly separated and treated as such all through the procedure.
- For manual bed disinfection, it is preferable to use a scrub-wipe method. Spray disinfection must be avoided. Strictly follow the methods recommended by the hospital, especially as concerns the quantities of disinfectant, product concentrations, and surfaces to be disinfected.
- When disinfecting beds entailing high risks of infection, protective clothing, gloves, and masks are to be provided to protect against both the chemical and infectious risks.

## 5.6. Room disinfection with gaseous formaldehyde

Considering the toxicological problems that this disinfection process raises (see section 1.1), it should be considered only after careful thought in cooperation with hospital hygiene and occupational safety experts.

The following rules are to be followed:

- This disinfection method is to be applied only in rooms that can be sealed off.
- The procedure to be followed is to be established in writing.
- The hospital's instruction must be followed strictly, notably as concerns the neutralization with ammonia.
- Disinfection is to be performed only by duly qualified and trained personnel.
- The rooms to be disinfected must be sealed off.
- A control area around the room (adjacent rooms and corridors) is to be defined and effectively monitored.
- No employees are to be present in the room during disinfection.
- Appropriate protective clothing and masks (see section 4.4.4) are to be provided for the personnel.
- Access to the room and control area is to be authorized again only when the measurement data so permit.
  - Provisional access may be authorized when formaldehyde and ammonia concentrations are constantly below the OEL values.
  - Final access for installing a patient should be authorized only when the formaldehyde and ammonia concentrations in the room air exhibit no risk for the patients.
  - It should be remembered that formaldehyde concentrations may temporarily rise again after neutralization with ammonia.

## 6. Medical surveillance

It is recommended that preventive occupational medical care be made available to employees assigned disinfection tasks. This is aimed at identifying any health problems due to disinfectants based on clinical and supplementary examinations, obtaining an impression of the working conditions during disinfection tasks, documenting exposure to disinfectant components as well as improving the information available to personnel as regards the measures to be taken for disinfection tasks.

The national regulations governing occupational medical surveillance must be observed.

The scope and intervals for occupational medical check-ups are based in particular on the disinfectants being used, on the intensity and duration of exposure as well as on the circumstances of the individual case.

Occupational medical examinations should in principle be performed before commencement of employment, and then at intervals of 1 – 3 years depending on the national legislation and workplace conditions. The examination should entail an anamnesis, including registration of conditions prevailing in the workplace, clinical status (taking account especially of the skin and upper and lower airways) and possibly supplementary examinations such as a lung function test or – if available – biological monitoring.

On the occasion of the periodic occupational medical examinations, the occupational physician should draw attention to collective and individual protective measures.

Where necessary, employment restrictions (see section 4.3.6) must be discussed and applied for.

In particular, pregnant women should discuss with the occupational physician their further assignments as soon as they discover that they are pregnant or even better at the time of planning pregnancy.



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